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1. Scope:

This specification establishes the requirements for the manufacture, inspection, test, identification and delivery of Nb-Ti superconducting, insulated cable for use in RHIC Helical dipole magnets. The seven-wire cable is to be fabricated using 0.013 in superconducting wire supplied by BNL. The cable is then electrically insulated with a polyimide polymer wrap.

The main emphasis of the specification is on adherence to a uniform production method for the conductor.

2. Applicable Documents:

The following documents in effect on the date of invitation to quote form a part of this specification to the extent specified herein. Unless otherwise specified, the issue date or revision level shall be that in effect on the date of invitation to quote.

- RHIC-MAG-R-8002 Nb-Ti Superconducting Wire for RHIC Helical Dipole Magnets
- BNL-QA-101 Brookhaven National Laboratory Seller Quality Assurance Requirements
- BNL DWG RD12011095 Helical Magnet cable "GO - NO GO" Gauge
- BNL DWG 12000028 Helical Dipole Conductor Wire
- BNL DWG 12000030 Helical Dipole Assy, Cable
- RHIC-MAG-R-8800 Specifications for Coil Cable Insulation

3. Requirements:

3.1 General: Any and all conflicts among the requirements listed in this procedure are to be brought to the attention of the buyer for resolution prior to the commencement of work. Under no circumstances is the seller to take any initiative without this resolution.

3.1.1 Technical Properties: The wire must be cabled on a high quality, fully controlled cabling machine. The required characteristics of the six around one cable are given in Table I.

Table I. Cable Dimensional and Mechanical Requirements

<u>Requirement</u>	<u>Value</u>	<u>Defined in Para. No.</u>
Number of wires in cable	7	3.1.1.1
Outside diameter of cable	0.039 +/-0.0003 in.	3.1.1.1
Cable Lay Pitch	0.375+/-0.04 in	3.1.1.2
Cable Lay direction	Left	3.1.1.2

Table I. Cable Dimensional and Mechanical Requirements. (Cont'd)

<u>Requirement</u>	<u>Value</u>	<u>Defined in Para. No.</u>
Cable Surface Condition	Clean and free from metallic particles and oil. The cable must be free of external roughness, sharp edges, or burrs that could damage the insulating material; no broken wires or crossovers.	3.1.1.6
Cable Lengths	Maximum Length on spool: 15,500 ft. Minimum unit length: Type A: 2,050 Ft. Type B: 1,900 Ft. Type C: 1,600 Ft.	3.1.1.5

- 3.1.1.1 Cable Dimensions: The conductor is a six-around one cable fabricated using 0.013" diameter superconducting wire as per BNL DWG. 12000029. The outside diameter of the cable should be controlled to the value given. This dimension for every cable length produced will be checked at the beginning and end of the cable run using a "Go- No Go" Gauge similar to the one shown in the BNL DWG. RD12011095.
- 3.1.1.2 The cable lay pitch is to be checked at the start of the cabling run and set to the value specified.
- 3.1.1.3 Cable Map: For each length of cable produced a wire map is to be delivered to BNL. This would record the identification and length of each of the seven wires. An example of a cable map is given in Appendix A. All footage should be referenced to the hub end of the delivered cable.
- 3.1.1.4 Cable Lengths: A unit length is defined as the minimum continuous length of conforming cable with no cold welded wire. There are three unit lengths specified in the table. A continuous length of cable delivered is to be a multiple of either unit length A, B or C, or a combination of multiple unit lengths of A, B and C. Identification of the delivered spool will be specified by BNL. All leaders used for cabling setup and which do not meet the cable requirements must be cut off and discarded.

The following conditions apply to the length of cable delivered:

- The maximum amount of cable on a spool will be 15,500 ft.
- Only multiples of cable unit lengths A and/or B and/or C adding up to 15,500 ft. are to be put on a spool.
- Only fully conforming cable be shipped to BNL.
- Based on a production length of cable(< 15,500 ft.) and the purchase order, the vendor shall propose cutting the cable. These "Cut Diagrams" shall be identified with the spool number and submitted to BNL. No cutting or separation will be required by the vendor.
- Cold Welds are not permitted.

- 3.1.1.5 Cable Surface Condition: The cable as produced will be free of any oil residue, metallic chips, broken wires and crossovers. The cable is to be cleaned if oil residue is present. If wire breakage occurs frequently, cabling should be stopped and the occurrence discussed with BNL before resuming cabling.
- 3.1.1.6 Cable Insulation: The cable is to be insulated with a polyimide polymer wrap in accordance with the specification RHIC-MAG-R-8800.

4. Quality Assurance Provisions:

The vendor shall maintain a quality assurance program to insure that each item offered for acceptance or approval conforms to the requirements herein.

4.1 Requirements of BNL-QA-101

- 4.1.1 The vendor shall accomplish the following requirements of BNL-QA-101, Brookhaven National Laboratory Seller Quality Assurance Requirements:

Paragraph in BNL-QA-101

- 3.1.2 MIL-I-45208 system specified
- 4.3
- 4.7 including 4.7.1
- 4.8
- 4.9
- 4.10 including 4.10.1, 4.10.2,
4.10.4, 4.10.5
- 4.12 see additional requirement in paragraph 4.2
- 4.16
- 4.1.2 BNL does not grant the Seller material review authority to accept as-is items that do not conform to the requirements of this procurement, or to repair items to a still nonconforming condition.
- 4.1.3 In the event of conflict between this specification and BNL-QA-101, this specification shall take precedence.

- 4.2 Data Transmittal: The vendor shall complete and submit to BNL the Cable Map and the Cut Diagram for the spools being shipped. Copies of these along with the cable samples are to be sent to BNL separate from the cable spool shipment.
- 4.3 Cable Samples: A ten ft.-long cable sample will be taken from every cable spool and sent to BNL. It must indicate whether the sample is from the hub or the lead end of the cable spool. Labels for the cable samples will be provided by BNL.
5. Preparation for Delivery:
- 5.1 Packing: The insulated cable will be shipped on non-metallic spools so that adequate protection is provided during shipment and handling. The spool shall be -12.0" O.D., 6.5" Hub Dia., 1.5" Dia. hole, 7.0" width. The completed spool shall be overwrapped with a cotton tape or substantially equal non-metallic material, which will prevent damage to the cable while preventing unwinding of the same.
- 5.2 Marking/Requirements: Spools and exterior packaging shall be identified on both flanges with the following information in the order shown:

"Superconductor Insulated cable for RHIC Helical Dipole Magnets" Specification No. RHIC-MAG-R-8003, Rev B BNL Dwg. No. <u>12000030</u> BNL P.O. No. _____ Cable Spool No. _____ Length _____ feet Weight _____ pounds Date of Manufacture _____ Name of Manufacturer _____	
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- 5.3 Cable Identification Numbers: The system for cable identification will be given to the vendor by BNL.

The only official copy of this file is the one on-line on the Superconducting Magnet Division website. Before using a printed copy, verify that it is the most current version by checking the document issue date on the website.

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APPENDIX A

Example of a CABLE MAP

Helical magnet cable					
Cable Map # 001					
Cable ID	Cabling Vendor	Cable Spool No.	Wire ID	Cable Length ft.	Comments
BNL-14-X-001	X	1	BNL-96-001	15,000	
		2	BNL-96-002	15,000	
		3	BNL-96-003	15,000	
		4	BNL-96-001	15,000	
		5	BNL-96-004	15,000	
		6	BNL-96-005	15,000	
		7	BNL-96-005	15,000	

REV. ZONE		ECN NO.	BY	DATE	CHK	APP
A			KAP	1-28-98		
INITIAL RELEASE						

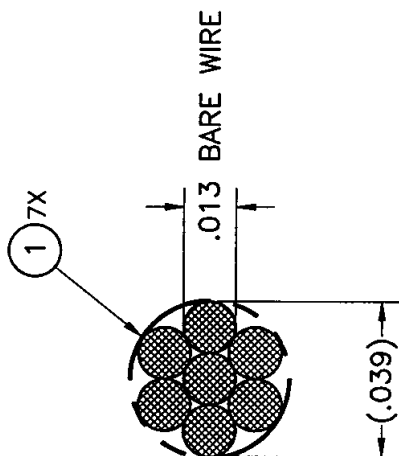
CONDUCTOR REQUIREMENTS			
ITEM	BARE WIRE DIA.	FILAMENT SIZE	COPPER : SUPERCONDUCTOR RATIO
1	.013	$\leq 10 \mu m$	2.5 : 1
			SPEC NO. RHIC-MAG-R-8002

OUTSTANDING ECN NUMBERS		INTERPRET IN GENERAL ACCORDANCE WITH ASME Y14.24M-1989	RHIC	BROOKHAVEN NATIONAL LABORATORY ASSOCIATED UNIVERSITIES, INC. UPTON, N.Y. 11973	
		UNLESS OTHERWISE SPECIFIED	K. Power	HELICAL DIPOLE CONDUCTOR WIRE	
		DIMENSIONS ARE IN INCHES	GENE KELLY	DRAWING NUMBER: 12000028	
		DECIMAL TOLERANCES	GENE KELLY	REV. A	
		.X \pm .08	GENE KELLY	SIZE B	
		.XX \pm .02	GENE KELLY	SCALE: NONE WEIGHT: NA	
		.XXX \pm .005	GENE KELLY	SHEET 1 OF 1	
		ANGULAR TOLERANCE \pm 1°	GENE KELLY	1200/0028A	
		BREAK SHARP EDGES	GENE KELLY	plot: 1/1	
		FINISH	GENE KELLY	1	
		MAX. NA MIN. NA	GENE KELLY	2	
		3	GENE KELLY	4	
		4	GENE KELLY	5	
		5	GENE KELLY	6	
		6	GENE KELLY	7	
		7	GENE KELLY	8	
		8	GENE KELLY	9	
		9	GENE KELLY	10	
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		95	GENE KELLY	96	
		96	GENE KELLY	97	
		97	GENE KELLY	98	
		98	GENE KELLY	99	
		99	GENE KELLY	100	

NOTES:

REV	ZONE	ECN NO.	DESCRIPTION	BY	DATE	CHK	APP
A			INITIAL RELEASE	KAP	1-28-98		

NOTES:
1. FOR CONDUCTOR CABLE SPEC SEE RHIC-MAG-R-8003.



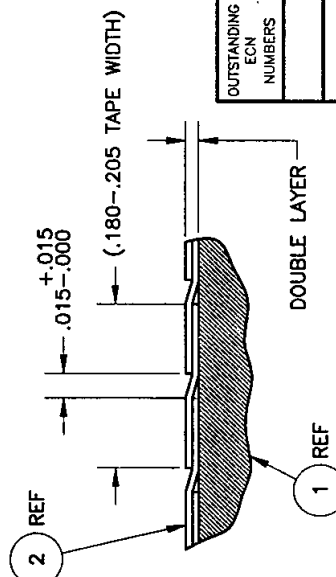
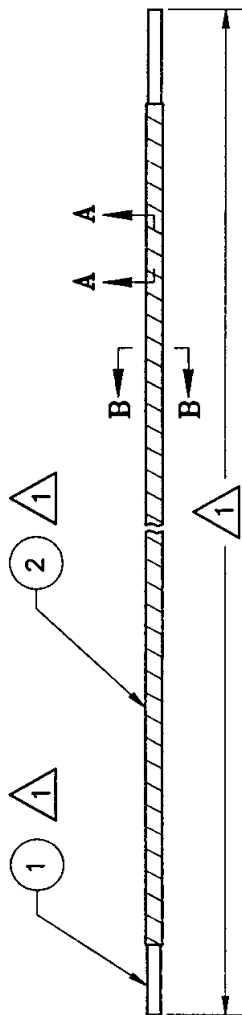
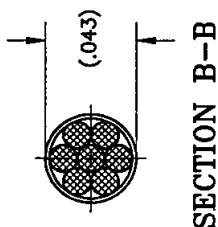
SEE SEPARATE PARTS LIST PL12000029

OUTSTANDING ECN NUMBERS		INTERPRET IN GENERAL ACCORDANCE WITH ASME Y14.24M-1989				BROOKHAVEN NATIONAL LABORATORY ASSOCIATED UNIVERSITIES, INC. UPTON, N.Y. 11973	
		UNLESS OTHERWISE SPECIFIED		DESIGN APPROVAL	1-28-98	TITLE:	
		DIMENSIONS ARE IN INCHES DECIMAL TOLERANCES		GENE KELLY	1-28-98	HELICAL DIPOLE ASSY, CABLE	
		.X ± .06		GENE KELLY	1-28-98	DRAWING NUMBER:	
		.XX ± .03		GENE KELLY	1-28-98	12000029	
		ANGULAR TOLERANCE ± 1°		GENE KELLY	1-28-98	REV. A	
		FINISH		B		SIZE	
		NA		B		DRAWING NUMBER:	
		BREAK SHARP EDGES		1		REV. A	
		MAX. UNL. NA		1		1200/0029A	
		3		2		SHEET 1 OF 1	
4		3		2		1200/0029A	
						plot 1/1	

FINAL

REVISIONS				
REV	ZONE	ECN NO.	DESCRIPTION	BY DATE CKR APP
A			INITIAL RELEASE	KAP 1-30-98

- NOTES:
- 1 FOR WIRE SPECIFICATION SEE RHIC-MAG-R-8002.
- 2 FOR WRAPPING SPECIFICATION SEE RHIC-MAG-R-8800.



SEE SEPARATE PARTS LIST PL12000030

OUTSTANDING ECN NUMBERS		INTERPRET IN GENERAL ACCORDANCE WITH ASME Y14.24M-1989		RHIC		BROOKHAVEN NATIONAL LABORATORY ASSOCIATED UNIVERSITIES, INC. UPTON, N.Y. 11973	
		UNLESS OTHERWISE SPECIFIED		DESIGN APPROVAL		TITLE: HELICAL DIPOLE ASSY, INSULATED CABLE	
		DIMENSIONS ARE IN INCHES		CHECKED		SIZE: B	
		DECIMAL TOLERANCES		ENGINEER		DRAWING NUMBER: 12000030	
		X ± .06		APPROVAL		REV. A	
		XX ± .03		SUPERVISOR			
		XXX ± .01		APPROVAL			
		ANGULAR TOLERANCE ± 1°					
FINISH		BREAK SHARP EDGES		SCALE: NONE		SHEET 1 OF 1	
NA		MAX. NA MIN. NA		WEIGHT: NA		1200/0030A	
3		4		1		PIEC 1/1	

SECTION A-A 2
FINAL